~~WO 97/32963~~ ~~PCT/EP/00192~~

~~Process for cleaning articles~~METHOD FOR CLEANING OBJECTS

[0001] This invention relates to a ~~process~~method for cleaning ~~articles~~objects and materials ~~made from of~~ metal, glass, ceramics, plastic(s), or composites thereof or of textiles.

[0002] Cleaning ~~processes~~methods, in which a vapor produced by heating ~~of~~ an active cleaning liquid is brought into contact with ~~articles to be cleaned~~the to-be-cleaned objects, are employed in the cleaning of a very wide variety of articles, such as metal ~~articles~~objects, industrially-manufactured ~~articles~~objects, such as printed circuit boards, articles of clothing, etc., ~~to remove undesirable foreign substances~~of undesired contaminants, such as ~~fats~~greases, lapping and polishing pastes, soldering pastes, adhesives, mixtures of inorganic (e.g., ~~saline~~salty) fouling substances and organic fouling substances (e.g., ~~ones~~ consisting of ~~fatty~~greasy residues), etc. Until recently, chlorinated hydrocarbons were typically used for such cleaning tasks. But now, ~~because of~~due to their ~~inadequate~~lack of environmental compatibility, ~~and~~ especially ~~because of~~due to their ozone destruction potential, their carcinogenicity~~,~~ and their toxic effect, ~~they~~chlorinated hydrocarbons have been banned or ~~use of them is allowed~~are usable only under very strictly defined conditions. One advantage of using chlorinated hydrocarbons was that such substances do not have ~~no~~a flash point at commonly-occurring temperatures. ~~Because of~~Due to the above-noted disadvantages, ~~indicated they~~ chlorinated hydrocarbons have been replaced by other hydrocarbons or solvents, such as polypropyleneglycol ethers, alcohols, acetone, ~~and the like~~etc. The latter have a flash point~~s~~ in the range of normally-occurring temperatures and are ~~consequently~~thus ignition hazard~~ous~~. They also present another disadvantage in that they hardly remove pigment fouling or fouling ~~with~~having ionic salts, since these solvents ~~are very inefficient in~~only poorly dissolv~~ing~~e pigments and/or salts ~~because of~~due to their ionic ~~nature of the latter~~character.

[0003] The object ~~of~~underlying the invention ~~was~~is to further develop a ~~generic~~conventional cleaning ~~process~~method so that it is performable ~~a good cleaning effect may be achieved~~ in an environmentally compatible manner while achieving a good cleaning effect.

[0004] Another object of the invention ~~was~~is to ~~prepare~~provide a new cleaning ~~process whereby~~method, by which mixtures of inorganic and organic fouling ~~may~~can be ~~eliminated~~ simultaneously removed in an efficient manner. Another ~~additional~~ object of the invention ~~was represented by preparation~~is to provide ~~of~~ a ~~process~~method for cleaning objects and materials made of metal ~~articles and materials which is not as harsh in the results of its operation as are state of the art processes~~that acts more gently than previously-known methods.

[0005] The previously-identified objects ~~referred to above~~ are attained by a ~~process~~method having the features ~~specified in~~of patent ~~C~~claim 1 ~~of the patent~~. Advantageous ~~developments~~embodiments of the ~~process claimed for the invention are presented~~inventive method are found in patent ~~C~~claims 2 to 19.

[0006] According to the invention, ~~A~~azeotropic preparations, ~~as claimed for the invention~~ which are usable as active cleaning liquids, ~~yield~~first have the advantage ~~above all~~ that their liquid phase effectively, ~~because of the aqueous component, their liquid phase efficiently~~ dissolves pigment fouling and fouling ~~with~~having ionic components, ~~such as~~e.g., salts, due to the water proportion ~~if~~when the azeotropic preparation used as the active cleaning liquid comes into contact with the ~~articles~~to-be-cleaned objects in the state of being a liquid. The molecules ~~containing lipophilic groups~~ of the at least one additional component containing lipophilic groups, which additional component is preferably also a liquid under ambient conditions or at low treatment temperatures, ensure ~~that~~a good fat-dissolving capacity of the azeotropic preparation ~~will possess efficient lipolytic capability~~.

[0007] If the azeotropic preparation used as the active cleaning liquid is heated, ~~because of its azeotropic nature (for a definition of "azeotrope" see Römpps Chemie Lexikon [Römpp's Chemical Dictionary], 9th Edition (1989), page 323)~~ both water and the other component(s) pass(es) into the vapor phase in a composition corresponding to ~~that of~~ the specific azeotrope due to its azeotropic character (for the definition of "azeotrope" see Römpps Chemie Lexikon [Römpp's Chemical Dictionary], 9th Edition (1989), page 323). ~~When~~Upon contacting the vapor of the azeotropic preparation ~~comes into contact~~ with the ~~articles to be cleaned~~to-be-cleaned object, a reliable cleaning and "rinsing" ~~from the articles to be cleaned~~ of ~~the~~all fouling substances of the to-be-cleaned object removed by the cleaning process ~~is effected~~ takes place.

[0008] It is particularly advantageous that the vapor~~, because of its high water content,~~ is not combustible due its high water content. Precautionary measures in this connection are ~~superfluous~~unnecessary in a device used for ~~application of~~carrying out the inventive method~~process claimed for the invention~~. The flash point of the vapor, to the extent that such a flash point exists at all, is above the temperatures normally occurring in such a cleaning ~~process~~method, but is at least above the boiling point of the liquid and ~~preferably~~is advantageously above about 200 °C. A flash point above 200 °C is therefore of special advantage,~~especially preferable in that~~ because the precautionary measures to be taken ~~in~~when carrying out the cleaning ~~process~~method are less extensive than when using active cleaning liquids ~~with~~having lower flash points~~are used~~. The azeotropic preparation, which is present in the form of a vapor at least in ~~one~~a part of the ~~process claimed for the invention~~inventive method, ~~may~~can be condensed into the liquid phase either on the ~~articles to be cleaned~~to-be-cleaned object or by lowering ~~of~~ the temperature, so that costly measures ~~to~~for protecting the atmosphere surrounding the device ~~applied~~ for carrying out the ~~process~~method, such as are required ~~in~~for conventional ~~processes~~methods, ~~may~~can be ~~dispensed with~~eliminated to the greatest possible extent.

[0009] Hence, an additional advantage of the ~~process claimed for the invention~~inventive method is ~~represented by~~ the fact that ~~very little of~~ the azeotropic preparation employed as the active cleaning liquid is scarcely ~~used because of~~consumed due to its recondensation ~~of the liquid~~ to the greatest extent possible. A closed loop ~~may~~can thus be created in which the azeotropic preparation used as the active cleaning fluid need not be replenished ~~not~~at all or only in negligibly small amounts. ~~An~~This is additionally aided ~~contribution to this result is made~~ by ~~the fact that~~making the inventive azeotropic preparation ~~as claimed for the invention~~ employed as the active cleaning liquid ~~may be~~ free of surfactants~~, which are deposited~~ that precipitate on the filter surface during filtration of the active cleaning liquid ~~in conventional processes~~ for ~~precipitation~~removing ~~of~~ the fouling substances in conventional methods and require ~~reinforcement~~a replenishment in conventionally-used solutions.

[0010] Surprisingly, with the ~~process claimed for the invention~~inventive method, ~~may also be used to remove~~ complex ~~kinds~~types of fouling substances, such as dried body fluids or other fouling substances, which occurring in everyday life as a result of ~~precipitation~~deposition

of fouling substances resulting from ~~in the form of~~ rain or snow, etc., are also removed from ~~articles to be cleaned~~the to-be-cleaned objects.

[0011] The ~~process claimed for the invention~~inventive method is not limited to closed systems. It ~~may~~can, for example, also be ~~applied~~carried out in the form of open ~~jet steam~~vapor stream cleaning.

[0012] ~~In selection of~~When selecting the inventive azeotropic preparations ~~claimed for the invention used~~employed as the active cleaning liquid and/or ~~of~~the other component(s) ~~which the preparations~~ contained therein, ~~with~~which have molecules ~~having~~with hydrophilic groups (e.g., -OH, $-NH_2$, -C-O-C-, -C(=O)-C-, -C(=O)-O, etc.) and lipophilic groups (e.g., CH_2-chains or C_1- to C_{12}-alkyl-, etc.), ~~emphasis is placed on the following criteria~~ in addition to good cleaning power, the following criteria stand in the foreground: The ~~moisture~~water content of the azeotrope ~~consisting~~ of water and (a) ~~another~~further component(s) ~~or other components~~ must be so high ~~enough so~~ that there is no flash point, ~~that is, so that~~ and/or that the vapor is not combustible. The liquid and the vapor formed ~~from it~~ by heating the liquid ~~must~~may ~~neither~~not be toxic ~~nor~~ have an ozone destruction potential, nor may ~~it~~they ~~trigger~~cause a water hazard if the preparation is inadvertently released into the environment. Water-soluble components forming homogeneous azeotropes or also water-insoluble components forming heterogeneous azeotropes are suitable.

[0013] In a preferred embodiment, the ~~process claimed for the invention~~inventive method for cleaning ~~articles~~objects comprises the steps ~~in which~~of:

-forming an azeotropic preparation ~~is formed of~~from water and at least one component ~~with~~having molecules ~~having~~with hydrophilic and lipophilic groups in a weight ratio (component(s) with hydrophilic and lipophilic groups) : ~~of~~water of 0.05 to 99.5 : 99.95 to 0.05;

~~-the articles to be cleaned are brought at least once~~ bringing the to-be-cleaned objects first into contact with the azeotropic preparation and allowing the liquid azeotropic preparation to drain off, ~~including~~inclusive of the ~~foreign substances~~contaminants from the to-be-cleaned objects removed ~~with it~~thereby, ~~is drained from the articles to be cleaned~~;

-removing residues of the azeotropic preparation on and/or in the ~~articles to be cleaned are removed~~to-be-cleaned objects by evaporation; and

-condensing the vapor of the azeotropic preparation ~~is condensed~~ and using the azeotropic preparation recovered by condensation ~~is used~~ for a ~~repeated~~ cleaning step once again.

[0014] ~~The foregoing corresponds to an especially~~Thus, it is accordance with a particularly preferred embodiment of the ~~process claimed for the invention~~inventive method~~, one in which articles to be cleaned are brought~~ to bring the to-be-cleaned objects into contact at least once ~~into contact~~ with the vapor of the azeotropic preparation and, during the duration of the contact, to allow the vapor of the azeotropic preparation ~~is allowed~~ to condense on the ~~articles to be cleaned~~to-be-cleaned objects. For example, the ~~articles to be cleaned may~~to-be-cleaned objects can be first brought into contact with the liquid azeotropic preparation ~~only~~ once or several times, for example~~,~~ by immersion, spraying, ~~sprinkling~~irrigation or ~~the like, processes in the state of the art already~~by comparable methods known in the prior art ~~for~~of ~~application~~forcefully contacting ~~of~~with a liquid. The ~~articles to be cleaned may~~to-be-cleaned objects can subsequently be brought into contact one or more times ~~into contact~~ with the azeotropic preparation in the form of the ~~latter's~~ vapor thereof. The vapor of the azeotropic preparation thereby continuously condenses ~~normally~~ on the ~~articles to be cleaned~~to-be-cleaned objects and ~~carries with it~~carries away residues of ~~foreign substances~~contaminants removed from the ~~articles to be cleaned~~to-be-cleaned objects as it drains off. As an alternative, however, the ~~process claimed for the invention may be applied by bringing articles to be cleaned immediately~~inventive method can be performed by bringing the to-be-cleaned objects into contact with a vapor of the azeotropic preparation~~,~~ at least once~~,~~ ~~but~~ preferably however several times. In this ~~instance~~case as well, the vapor condenses during the duration of the contact on the ~~articles to be cleaned~~to-be-cleaned objects and thereby removes the ~~fouling substances~~contaminants.

[0015] In an especially preferred embodiment of the ~~process~~method, ~~use is made of~~ an azeotropic preparation ~~of~~made from water and at least one component ~~with~~having molecules ~~having~~with hydrophilic and lipophilic groups is used, ~~a preparation~~ in which the weight ratio (~~of~~ component(s) ~~having~~with hydrophilic and lipophilic groups) ~~:to~~ water is in the range of 1.0 to

35.0 : 99.0 to 65.0, and even more ~~to be preferred~~preferably is in the range of 4.0 to 15.0 : 96.0 to 85.0.

[0016] ~~Corresponding to~~It is in accordance with another preferred embodiment of the ~~process claimed for the invention~~inventive method to ~~is~~ use ~~of~~ an azeotropic preparation in the form of a mixture ~~of~~made from water and at least one additional component ~~with~~having molecules ~~having~~with hydrophilic and lipophilic groups as the active cleaning liquid, wherein the additional component(s) and the water form~~ing~~ an azeotrope ~~in~~at the ~~liquid phase to vapor~~ phase transition liquid phase/vapor phase and the azeotrope ~~being~~is an azeotrope ~~with~~having an immiscibility gap at a temperature ~~ranging from~~between 0 °C ~~to~~and the temperature of the phase ~~liquid phase to vapor phase~~ transition liquid phase/vapor phase at standard ~~under normal~~ pressure. Surprisingly, it has been found, in particular, that the azeotropes ~~with~~having immiscibility gaps ~~possess~~have particularly advantageous cleaning properties. ~~Particular preference is to be given to an~~An azeotrope ~~with~~having an immiscibility gap at a temperature ranging from 20 °C to 110 °C ~~under~~at standard ~~normal~~ pressure is particularly preferably used.

[0017] ~~The~~By the term "~~under normal~~at standard pressure", ~~is to be understood in the specification and in the claims to mean~~ atmospheric pressure (approximately 1 ~~or~~atm; about 10^5 Pa) is understood in the description and in the patent claims.

[0018] ~~While at this point~~Without being committed to a ~~no~~ theoretical ~~interpretation has been arrived at for~~explanation of the invention at this time, it has been found that azeotropic preparations, which ~~may~~can be used as an active cleaning liquid in the ~~process claimed for the invention~~inventive method, are clear at low temperatures ~~ranging~~of, for example, ~~from~~ 20 to 25 °C. In other words, the components are fully dissolved in each other. ~~Specific component composition relationships~~Defined ratios of the composition of the components ~~are established at each temperature~~ in the mixed phase arise for each temperature. The phases, which are separated at ~~high~~an elevated temperature~~s~~, can be converted into an emulsion, which appears milky, ~~in appearance by means of suitable process~~through appropriate method steps, such as preferably ~~treatment with~~through exposure to ultrasound, through intensive movement ~~during transfer~~ by pump-transferring or agitation, etc. This emulsion ~~exhibits~~has discontinuous droplets of the organic component(s) in a continuous aqueous phase. The emulsion ~~possesses~~has an excellent fat-dissolving ~~capability on the basis of~~capacity due to its content of organic components

(~~with~~having molecules ~~having~~with lipophilic groups)~~,~~ ~~but on the basis of~~ however, due to the continuous aqueous phase, it also dissolves water-soluble, e.g., ionic, ~~fouling substances~~contaminants, such as salts. ~~When~~With further increases of the temperature of ~~an~~the azeotropic preparation ~~is raised further, the preparation~~it passes into the vapor phase, in which vapor phase the components are present in the ~~specific~~special composition typical ~~of~~for the ~~particular~~respective azeotrope. During condensation, the azeotropic preparation again migrates through the immiscibility gap; consequently, condens~~ing~~ed vapor of the azeotropic preparation is present again ~~on the articles to be cleaned,~~ in the form of the emulsion on the to-be-cleaned objects, which emulsion has~~possesses~~ excellent dissolving properties ~~both~~ for ~~lipid and for~~oily contaminants as well as ionic ~~fouling substances~~contaminants.

[0019] In the light of the criteria indicated above, some organic components, which form homogenous azeotropes with water, are ~~given preference~~preferred for use as organic components in azeotropic preparations that are employed for ~~application of~~carrying out the ~~process claimed for this~~method according to the present invention. As ~~may~~is readily ~~be discerned by~~ascertainable for experts in this ~~area of the art~~technical field, the invention is nevertheless not limited to the preferred, azeotrope-forming compounds ~~forming azeotropes~~.

[0020] The preferred compounds can best be described by the following general formula:

$$R^1 - [X]_n - R^3$$

where~~in~~:

- R^1 and R^3 each represent: H independently of each other; straight-chain or branched saturated or unsaturated C_1- to C_{18}–alkyl groups, in which one or more nonadjacent $-CH_2-$ groups ~~may~~can be replaced by -O-; saturated or unsaturated cyclic C_1- to C_8–alkyl groups, in which one or more nonadjacent $-CH_2-$ groups ~~may~~can be replaced by -O-; hydroxy; C_1- to C_8-alkoxy; amino, where~~in~~ one or both hydrogen group(s) ~~may~~can be replaced by C_1- to C_8–alkyl groups; and

- X represents~~:~~ -O-~~;~~ -C(=O)-; -C(=O)-O-; -NH-~~;~~ -NR^1-; -N(-OH)-; straight-chain or branched - (C_1- to C_8-) alkylene groups, in which one or more nonadjacent $-CH_2$- groups ~~may~~can be replaced by -O-; and n represents integers 1, 2, 3, etc.

[0021] In other words, the organic components of the azeotropic preparations, which ~~may be~~are used in the ~~process claimed for this~~method according to the present invention, ~~may~~can be selected from ~~among~~ organic compounds that belong~~ing~~ to the groups of alcohols, glycols, amines, ethers, glycol ethers, esters, ketones, and amino alcohols ~~and from among~~as well as N-heterocycl~~ene~~ics or organic acids.

[0022] In ~~an especially~~a particularly preferred ~~procedure~~method, compounds of the general formula indicated above are used as (an) organic component(s) ~~or components~~ of the azeotropic preparation or as (an) additional organic component(s), ~~or components~~ in which R^1 and R^3 each independently represents saturated or unsaturated C_1- to C_{12}-alkyl groups, ~~and with even greater preference~~more preferably saturated or unsaturated C_1- to C_8-alkyl groups, in which one or more nonadjacent CH_2 group(s) ~~may~~can be replaced by -O-~~;~~ ~~may represent~~ hydroxy, C_1- to C_8-alkoxy and unsubstituted amino groups or amino groups substituted with alkyl groups ~~substituted amino groups~~; and/or X represents -O-; - C(=O)-; -C(=O)-O-; -NH-; -NR^1-; -N(-OH)-~~;~~ -OCH(R^2)-CH_2- (wherein R_2 represents H or methyl); and n represents 1 or 2~~).~~

[0023] Specific examples of the groups represented by R^1 and R^3 are hydrogen, methyl, ethyl, n-propyl, i-propyl, n-butyl, sec-butyl, i-butyl, tert-butyl, n-pentyl, n-hexyl, n-octyl, furfuryl-2, tetrahydrofurfuryl-2, hydroxy, methoxy, ethoxy~~,~~ and propoxy. Specific examples of the groups represented by ~~X~~X are -O-; -C(=O)-~~;~~ -C(=O)-O-; -NH-; -NR^1-; -N(-OH)-; ethyleneoxy~~,~~ and propyleneoxy.

[0024] Even more preferred ~~processes as claimed for the~~methods according to the present invention employ compounds of the general formula indicated above as (an) organic compound(s) ~~or compounds~~ of the azeotropic preparations or as (an) additional organic component(s), which ~~or~~ component(s) ~~which~~ are selected from ~~among those in~~ the group:

- (C_1- to C_{12}-~~A~~alkyl) - C(=O)-O - (C_1- to C_{12}-~~A~~alkyl);
- (C_1- to C_{12}-~~A~~alkyl) - O - (C_1- to C_{12}-~~A~~alkyl);

- (C_1- to C_{12}-Aalkyl) - C(=O) - (C_1- to C_{12}-Aalkyl);
- (C_1- to C_{12}-Aalkyl) – [N - (H or C_1- to C_{12}-Aalkyl) (H or C_1- to C_{12}-Aalkyl)];
- HO-$(CH_2)_{1, 2 \ldots \text{etc.}}$ – [NH_2 or NH(C_1- to C_{12}-Aalkyl) or N(C_1- to C_{12}-Aalkyl)$_2$];
- H - [O - CH(H or CH_3) - $CH_2]_{1, 2 \ldots \text{etc}}$ - OH; and
- (H or C_1- to C_{12}-Aalkyl) - [O -CH(H or CH_3) - $CH_2]_{1, 2 \ldots \text{etc.}}$ – [OH or O(C_1- to C_{12}-Aalkyl)].

[0025] ~~Specific~~Special examples of organic ~~components~~compounds, which ~~may~~can be used, either ~~singly~~alone or ~~together~~collectively in groups of a plurality of the mentioned compounds, ~~named~~ in azeotropic preparations of the active cleaning liquid, are selected from ~~the group comprising~~ propyleneglycol ether; dipropyleneglycolmonomethylether; dipropyleneglycolmono-n-propylether; tripropyleneglycolmonomethylether; 3-methoxy-3-methylbutanol; furfuryl alcohol; tetrahydrofurfurylalcohol; 1-aminobutonol-2; monoisopropanolamine; 2-amino-2-methylpropanol-1; 2-amino-a2-methylpropanediol-1,3; 3-(aminomethyl-)pyridine; ethanolamine; furfurylamine; methyl lactate; isopropyl lactate; aminoacetaldehydedimethylacetal; 4-aminomorpholine; 1-methylimidazole; 1,2-dimethylimidazole; 1-vinylimidazole; 1,4-diazabicyclo[2.2.2]octane (DABCO); 1,5-diazabicyclo[4.3.0]non-5-ene; and 1,8-diazabicyclo[5.4.0]undec-7-ene.

[0026] ~~Addition to~~ It is in accordance with a further, also preferred, embodiment to add at least one cleaning booster, which does not independently vaporize, to the active cleaning liquid for the inventive method~~process claimed for the invention of at least one cleaning booster which does not spontaneously evaporate corresponds to another especially preferred embodiment~~. It or they should preferably ~~be~~ distilled with the azeotropic preparation. Such cleaning boosters, which do not ~~spontaneously evaporate~~independently vaporize, are known to the ~~expert~~skilled person from the ~~state of the art~~prior art and therefore require no further ~~specification~~enumeration at this ~~point~~time.

[0027] ~~It~~Likewise, it is ~~also claimed for the~~preferable in accordance with the invention ~~that it is preferable~~ to add at least one corrosion ~~proofing~~prevention additive to the active cleaning liquid. ~~Such additive or additives~~It or they should preferably ~~be~~ distilled with the

azeotropic preparation. Such corrosion ~~proofing~~prevention additives are particularly advantageous when ~~articles~~objects made of nonferrous heavy metals or light metals ~~are to~~should be cleaned. For example, ~~excellent cleaning of~~ aluminum articles can be ~~accomplished~~ cleaned with excellent results using ~~with~~ an azeotropic preparation comprising 1-methylimidazole, ~~which~~It acts as an inhibitor. The cleaning of~~Copper~~ parts made of copper ~~may~~can also be ~~cleaned to advantage~~carried out in an advantageous manner with azeotropic preparations comprising 1-methylimidazole. Brightening of the surface is achieved ~~in the process~~thereby. Instead ~~place~~ of the above-mentioned compound ~~indicated, use may also be made of~~ other corrosion ~~proofing~~prevention additives and corrosion prevention inhibitors can also be added, as are known to the ~~expert~~skilled person from the ~~state of the~~prior art.

[0028] Especially ~~to be~~ preferred, as yielding excellent cleaning results, are ~~processes~~methods for cleaning ~~articles as claimed for~~objects according to the invention, in which an azeotropic preparation made of water and an organic component is ~~added~~used as the active cleaning liquid. ~~By preference~~In this case, the organic component is ~~in this instance~~preferably a compound that is selected from ~~among those in the~~ group: ~~comprising~~ dipropyleneglycolmonomethylether; dipropyleneglycolmono-n-propylether; tripropyleneglycol monomethylether; 3-methoxy-3-methylbutanol; furfuryl alcohol; tetrahydrofurfuryl alcohol; 1-aminobutanol-2; furfuryl amine; methyl lactate and isopropyl lactate.

[0029] The indicated compounds ~~indicated~~ belong to the following groups of compounds ~~of~~having the general formula R^1 -$[X]_n$ - R^3:

(A) Glycol ethers:

- organic component No. 1: dipropyleneglycolmonomethylether

$R^1 = CH_3$; $R^3 = OH$; $X = OCH_2\text{-}CH(CH_3)$-; n = 2;

- organic component No. 2: tripropyleneglycolmonomethylether

$R^1 = CH_3$; $R^3 = OH$; $X = OCH_2\text{-}CH(CH_3)$-; n = 3;

- organic component No. 3: 3-methoxy-3-methylbutanol

$R^1 = CH_3$; $X = O\text{-}C(CH_3)_2\text{-}(CH_2)_2$-; n = 1;

-_organic component No. 4: dipropyleneglycol-n-propylether

R^1 = n-C_3H_7; R^3 = OH; X = OCH_2-$CH(CH_3)$-; n = 2;

(B) Alcohols:

-_organic component No. 5: furfuryl alcohol

R^1 = Furfuryl-2; X = O; R^3 = H; n = 1;

-_organic component No. 5: tetrahydrofurfuryl alcohol

R^1 = Tetrahydrofurfuryl-2; X = O; R^3 = H; n = 1;

(C) Amines:

-_organic component No. 7: 1-aminobutanol-2

R^1 = OH; X = sec-Butyl; R^3 = NH_2; n = 1;

-_organic component No. 8: furfurylamine

R^1 = Furfuryl-2; X = -NH-; R^3 = H; n = 1;

-_organic component No. 11: 2-amino-2-methylpropanol-1

R^1 = CH_3; X = CH_3 - C - CH_2OH; R^3 = -NH_2; n = 1;

-_organic component No. 12: 2-amino-2-methylpropanediol-1,3

R^1 = $HOCH_2$; X = CH_3 -C - CH_2OH; R^3 = -NH_2; n = 1;

(D) Esters:

-_organic component No. 9: methyl lactate

R^1 = Hydroxyethyl; X = C(=O)O-; R^3 = CH_3; n = 1;

-_organic component No. 10: isopropyl lactate

R^1 = Hydroxyethyl; X = C(=O)O-; R^3 = i-C_3H_7; n = 1;

[0030] In such azeotropic preparations ~~of this kind~~ to be used as an active cleaning liquid in the ~~process claimed for the invention~~inventive method, water and an organic component are ~~to be added~~present in relative amounts of (100 - x) ~~percent by weight~~wt% : x ~~percent by weight~~wt%. ~~In this statement~~Herein, x is in the ranges ~~from~~of $0 < x \leq 35$, ~~is~~ preferably in the range $3 \leq x \leq 25$, ~~and by special preference~~particularly preferably in the range $4 \leq x \leq 15$.

[0031] In another preferred ~~process~~method, the mixture ratio of water ~~to~~and the other component(s) in the azeotropic preparation is substantially set ~~more or less~~ at the ratio, which is present in the vapor ~~as at~~that results ~~of~~by heating ~~of~~ the liquid azeotropic preparation.

[0032] In another, also preferred, embodiment, the ~~process claimed for the invention~~inventive method for cleaning ~~articles~~objects includes a step ~~in which~~of using an azeotropic preparation made of water and two organic components ~~is used~~ as the active cleaning liquid. ~~By particular preference use is made of the active cleaning liquid of an~~An azeotropic preparation ~~consisting~~made of water, dipropyl~~o~~neglycolmono-n-propylether and an additional organic component is particularly preferably used as the active cleaning liquid. ~~The~~In this embodiment, further components can also be contained in the azeotropic preparation employed as the active cleaning liquid ~~may, of course, also contain other components~~, ~~such as~~for example at least one cleaning booster, which does not ~~spontaneously evaporate~~independently vaporize and ~~by special preference is~~more preferably distill~~ed~~ with the azeotropic preparation, ~~a cleaning booster such as~~ is known from the ~~state of the~~prior art and has already been ~~referred to in the foregoing~~mentioned above, and/or at least one corrosion ~~proofing~~prevention additive or corrosion ~~proofing~~prevention inhibitor (~~by special preference~~more preferably, one that distill~~ed~~ with the azeotropic preparation), ~~such as~~ is also known ~~as such or is known~~ from the ~~state of the~~prior art and has already been ~~referred to in the foregoing~~mentioned above.

[0033] In accordance with this preferred embodiment, ~~by special preference~~ it is particularly preferred to use ~~is made as an additional organic component of a~~ compound ~~in~~from the following group as additional organic components: 1-aminobutanol-2; monoisopropanolamine; 2-amino-2-methylpropanol-1; 2-amino-2-methylpropanediol-1,3; 3-(aminomethyl-)pyridine; ethanolamine; aminoacetaldehydedimethylacetal; 4-aminomorpholine; 1-methylimiazole; 1,2-dimethylimidazole; 1-vinylimidazole; 1,4- diazabicyclo[2.2.2]octane (DABCO); 1,5-diazabicyclo[4.3.0]non~~e~~-5-ene; and 1,8-diazabicyclo[5.4.0]undec-7-ene.

[0034] The mentioned organic compounds ~~indicated may~~can be used ~~singly~~alone or in combination with each other.

[0035] ~~Also to be given particular preference is~~It is also particularly preferred to use ~~of~~ an additional organic component ~~of~~from the group: ~~made up of~~ acetic acid, hydroxyacetic acid, formic acid~~,~~ and butyric acid. The indicated acids ~~in question may~~can also be used ~~individually~~alone or in combination with each other or with other substances, such as the organic components named above.

[0036] In accordance with the above-described preferred embodiment, ~~just described use is made as active cleaning liquid of~~ an azeotropic preparation ~~consisting~~made of water, a glycol ether (preferably dipropyleneglycolmono-n-propylether) and an additional organic component is used as the active cleaning liquid in relative amounts of 90 ~~percent by weight~~wt% : (10 - y) ~~percent by weight~~wt% : y ~~percent by weight~~wt%, wherein y is in the range of $0 < y \leq 5$, ~~and by special preference~~particularly preferably $0 < y \leq 2$.

[0037] ~~A schematic drawing is presented~~A device, in which the inventive method can be carried out, is schematically illustrated in the ~~attached drawing of a device in which the process claimed for the invention may be applied~~appended Figure: ~~A~~a ~~storage~~reservoir tank 2 ~~with~~having a ~~separation compartment~~precipitation chamber 4 and an overflow ~~compartment~~chamber 6 is connected ~~by way of~~via a feed pump 8 and a heating device 10 to a cleaning device 12. The interior of the cleaning device, whose structure is ~~of the state of~~ known in the prior art and which ~~may~~can include cleaning nozzles, a ~~revolving~~circulating basket, etc., is connected, in the example shown in the ~~F~~Figure, ~~is connected~~ to a pressure compensation vessel 14, which is, ~~however, is~~ not essential for operation.

[0038] ~~Piping~~A conduit leads from the bottom of the cleaning device 12 to a filter device 16. The filter device 16 is connected ~~by way of piping~~via a conduit ~~to~~with a feed pump 18 on the top side of the ~~separation compartment~~precipitation chamber 4. ~~Additional piping~~Another conduit ~~extends~~leads from the filter device 16 back to the precipitation chamber 4 via ~~by way of~~ a vacuum pump 20 through a condenser 22 and a cooler 24 ~~back to the separation compartment~~ 4.

[0039] ~~Piping also extends~~A conduit further leads from the overflow compartment 6 into a distillation device 30 ~~by way of~~via a ~~delivery~~feed pump 26 through a heat exchanger 28 ~~into a distillation device 30~~ and ~~thence~~from there ~~back~~ into the cleaning device 12 or back to the ~~storage~~reservoir tank 2.

[0040] A feed line 32 ~~charging the storage tank 2 with active cleaning liquid extends~~ leads into the ~~storage~~reservoir tank 2 for filling the reservoir tank 2 with the active cleaning liquid. The ~~storage~~reservoir tank 2 also contains a not-illustrated device~~, not shown,~~ for ~~removal~~drawing off sludge that deposit~~ed~~ in the ~~separation compartment~~precipitation chamber 4.

[0041] Ventilation piping 34 ~~extends~~leads into the normally-sealed cleaning device 12.

[0042] The structure of the individual structural elements of the described cleaning device 12 and an electronic control ~~unit~~ (not shown) ~~for~~of the individual ~~structural components is of the state of the art~~assemblies are known and ~~is consequently~~are therefore not described in detail.

[0043] The function of the described device ~~described operates~~is as follows~~:~~. After charging the cleaning device 12 ~~has been charged~~ with ~~an~~ to-be-cleaned item ~~article or articles to be cleaned~~, a liquid cleaning takes place in an exemplary but not restrictive embodiment, ~~first liquid cleaning is carried out~~ in which the feed pump 8 is actuated and the active cleaning liquid, ~~whose~~the temperature ~~may~~of which can ~~if desired~~ be adjusted in the heating device 10 if necessary, is fed into the cleaning device 12. ~~In the cleaning device 12 the revolving~~An immersion bath of the circulating cleaning item ~~article or articles to be cleaned is/are immersed~~ and/or a spraying of the cleaning item ~~article or articles to be cleaned are sprayed~~ with liquid takes place in the cleaning device 12. The liquid is removed from the cleaning device 12 through the filter device 16 by the feed pump 18 and is fed into the ~~separation compartment~~precipitation chamber 4. Predominantly inorganic fouling substances ~~are~~ precipitate~~d~~ in the filter device 16 and are ~~removed~~drawn off. Predominantly ~~fatty~~fat-containing fouling substances ~~are~~ precipitate~~d~~ in the ~~separation compartment~~precipitation chamber 4 and are also ~~removed~~drawn off.

[0044] The exemplary-described liquid cleaning stage ~~described as an example~~ is followed by rinsing under the same conditions with active cleaning liquid from the tank 6.

[0045] ~~The rinsing is followed by~~Then, a ~~steam~~vapor cleaning stage and/or ~~steam~~a vapor rinsing stage takes place, in which the feed pump 26 is actuated ~~and thus~~so that the active cleaning liquid is heated in the distillation device 30 and is converted into vapor. ~~Because of~~As a consequence of the azeotropic ~~nature~~character of the azeotropic preparation employed as the active cleaning liquid, this vapor has a predetermined content of water and the additional component(s) ~~or components~~. The ~~composition of the~~ liquid azeotropic preparation ~~is~~is preferably already composed from its components so that~~such that it~~ they also corresponds ~~in point of~~to the content to the corresponding components in the vapor phase. In the cleaning device 12 the vapor comes into ~~vigorous~~intensive contact with the to-be-cleaned item ~~article or articles to be cleaned~~, wherein at least a part of the vapor ~~is~~ condenses~~d~~. The condensate is supplied by feed pump 18 ~~delivers the condensate~~ to the precipitation ~~compartment~~chamber after ~~this condensate has passed~~flowing through the filter device 16.

[0046] ~~The liquid may be reconditioned if~~When the vapor is fed back into the ~~storage~~reservoir tank 6 from the distillation device 30 ~~by way of~~via the condenser 22 and the cooler ~~14~~24, the liquid can be purified thereby.

[0047] The vapor cleaning or vapor rinsing is advantageously followed by recirculating ~~air~~ drying or vacuum drying. ~~In the process the~~The vapor present inside the cleaning device 12 is ~~drawn~~thereby suctioned off by the vacuum pump 20, wherein the condensate formed in the cleaning device 12 ~~passing~~flows through the filter device 16. The vapor mixed with the condensate is ~~returned~~again supplied to the ~~storage~~reservoir tank 2 as a liquid after ~~passing~~flowing through the condenser 22 and cooler 24.

[0048] After vacuum drying has been completed, the ~~separation compartment~~precipitation chamber 4 is ~~aerated by way of~~ventilated via the ~~aeration~~ventilation line 34, and the cleaned ~~article(s) may~~item can be removed.

[0049] In an alternative embodiment, which also yields favorable results, ~~articles to be treated~~to-be-treated objects are sprayed in the cleaning device 12 with the azeotropic preparation used as the active cleaning liquid. ~~In this process~~This happens in the way that ~~articles to be cleaned~~the to-be-cleaned objects are ~~soaked in~~saturated with the liquid. The subsequent

~~process~~method steps are ~~more or less~~essentially the same as ~~those~~were described ~~in the foregoing~~above.

[0050] After the treatment, the to-be-treated objects ~~articles treated~~ are in a distinctly better condition than after treatment in a conventional ~~process~~method, ~~that is,~~i.e. by ~~use of~~using ~~conventional organic~~customary solvents for the cleaning steps under identical conditions. In particular, it has been ~~found,~~ surprisingly, determined that not only are all organic fouling substances, ~~in particular~~inclusive of lipophilic and/or oily or fatty substances, removed, but also all the inorganic fouling substances, in particular inorganic salts from perspiration, color~~ing~~ pigments, etc., ~~are removed in addition to all organic fouling substances such as lipophilic or oleaginous or fatty substances.~~ The treated objects ~~articles treated~~ have no unpleasant odor and ~~are~~exhibit an excellent ~~outstanding in~~ appearance.

[0051] As was ~~stated earlier~~already explained above, azeotropic preparations ~~with~~having an immiscibility gap exhibit a surprisingly ~~efficient~~good cleaning behavior distinctly superior to that of conventional preparations.

[0052] ~~Whenever use is made of~~In the case of using azeotropic preparations ~~with~~having an immiscibility gap, ~~in treatment in the liquid phase articles to be cleaned~~ the to-be-cleaned objects are brought into contact with an azeotropic preparation when treating in the liquid phase, which azeotropic preparation is in a state, ~~such that~~ in which the components of the azeotropic preparation are present in separate, or at least partly separate, phases. For example, the liquid azeotropic preparations present in ~~a~~the state of phase separation are treated with ultrasound or are ~~vigorously~~intensively pump-transferred ~~by pumping~~ or agitated, so that a milky emulsion of the azeotropic preparation is ~~formed~~. This emulsion ~~efficiently~~effectively dissolves not only fatty or oily components, but also ionic and/or ~~saline~~salty contaminants ~~fouling substances as well~~.

[0053] ~~Whenever articles to be cleaned are treated~~In the case of treating to-be-cleaned objects with the azeotropic preparation in the vapor phase, ~~as described above~~ the azeotropic preparation is heated as previously described and a vapor is produced, in which the components are present in the quantitative proportions that are determined by the characteristic azeotropic properties. The vapor condenses at least ~~to some extent~~partially on the ~~articles to be cleaned~~to-be-cleaned objects, and the same milky emulsion ~~is obtained~~arises as in the liquid phase.

~~Efficient dissolving of fats and salts~~An excellent oil- and salt-dissolving capacity is also observed in this ~~instance as well~~case.

[0054] ~~When~~By increasing the temperature of the azeotropic preparation ~~is raised~~ to the ~~point~~phase transition ~~of~~ liquid phase/vapor phase ~~transition~~, the components pass into the vapor phase in the quantitative proportion corresponding to ~~that of~~ the azeotrope, and the azeotropic preparation can be ~~produced~~purified by distillation without ~~any~~ problem.

[0055] The last ~~named~~mentioned embodiment of the ~~process claimed for the invention~~inventive method is particularly ~~favorable~~advantageous for ~~the~~ cleaning ~~of~~ metal parts. Thus, for example, lapping and polishing pastes can be ~~very efficiently~~highly effectively removed from metal parts by ~~use of~~using azeotropes ~~with~~having an immiscibility gap. For instance, an azeotropic preparation ~~compounded~~mixed with acidic additives is used as the active cleaning liquid for this purpose. The ~~C~~cleaning ~~is carried out~~takes place in the above-described ~~one-compartment~~ chamber system ~~described above~~ and ~~may be conducted~~can take place continuously or in a batch process.

[0056] Likewise, SMD adhesives (SMD = surface mounted devices), such as are employed in the manufacture of SMD components for double-sided mounting, can also be removed surprisingly well from electronic components, whereby ~~produced in double-sided assembly to prevent~~the components ~~from being~~do not detached during the soldering process. The adhesive is ~~customarily~~usually applied ~~by way of~~via dispenser systems or templates before the printed circuit boards are ~~secured~~attached. Defectively- printed/~~- or-~~dispensed circuit boards and/or templates ~~may~~can be cleaned. Surprisingly, cleaning results can be achieved with the azeotropic preparations employed according to the invention that distinctly ~~superior to~~surpass those ~~obtained~~achieved with conventional solvents such as butyl acetate or isopropanol ~~can be obtained with the azeotropic preparations used as claimed for the invention~~. In addition, precautionary measures (such as those taken to prevent explosions when correspondingly hazardous solvents are used) are ~~superfluous~~unnecessary.

[0057] ~~The azeotropic preparations indicated may be used similarly by the process claimed for the invention to remove excess~~In the same way, surplus soldering paste applied during soldering can be removed ~~simply and in an environmentally friendly manner~~ from

defectively-printed ~~circuit~~ boards and templates in a simple and environmentally-friendly manner. ~~It is also possible to remove excess~~The removal of fluxing agent residues after soldering is likewise possible. ~~Cleaning is accomplished~~The cleaning takes place by spraying, spray rinsing, and drying of ~~articles to be cleaned~~the to-be-cleaned objects, preferably in ~~an~~the immersion process ~~involving~~with ultrasound (cleaning stage), rinsing with or without ultrasound (rinsing stage)~~,~~ and drying. The ~~C~~cleaning is carried out preferably at a temperature in the range of 40-60 °C, but it is not restricted to this temperature range. The temperature may be significantly higher, for example, it may even exceed 100 °C, ~~especially in treatment of articles to be cleaned~~in particular when treating the to-be-cleaned objects during the cleaning stage with the vapor of the azeotropic preparation.

[0058] Particularly ~~preference is given to use of~~preferably, the azeotropic preparations ~~presented in~~according to the following Table I ~~below~~are used for cleaning ~~processes as claimed for~~methods according to the invention. ~~Also given in this table are the~~The preferred proportions of organic components (O.~~K~~C.) : ~~to~~ water, the boiling points of ~~a particular~~the respective azeotropic preparations, ~~and~~as well as the temperatures, at which ~~exemplary treatment of articles to be cleaned may be carried out~~to-be-cleaned objects can be treated in an exemplary manner, are provided in this Table. The invention is not, of course, restricted to the proportions of the indicated components and treatment temperatures ~~indicated~~.

[0059] In the ~~event~~case of ~~use of~~using azeotropes ~~with~~having an immiscibility gap, ~~particular preference is given to~~three-component-mixtures made of water, dipropyleneglycolmono-n-propylether, and amine compounds and/or ~~n~~N-heterocyclic compounds or organic acids~~, as shown in~~ according to the following Table II ~~below~~are particularly preferably used. An exemplary, but not ~~restrictive~~limiting, composition of the azeotropes is as follows: water (90 ~~percent by weight~~wt%), dipropyleneglycolmono-n-propylether (10 - y ~~percent by weight~~wt%), y ~~percent by weight~~wt% of the compounds indicated in Table II.

[0060]

Table I

Azeotropic Preparation		Boiling Point (°C)	Treatment Temperature (°C)
Organic Components (O.C~~K.~~)	~~O.K. to~~Ratio O.C. : Water ~~Ratio~~		
No. 1	8.9 : 91.1	99.2	60
No. 2	7.9 : 92.1	99.1	60
No. 3	11 : 89	99 – 101	65
No. 4	10 : 90	100	65
No. 5	20 : 80	98.5	65
No. 6	10.5 : 89.5	102	65
No. 7	4.7 : 95.3	102	65
No. 8	30.9 : 69.1	100	60
No. 9	20 : 80	99.5	60
No. 10	34 : 76	98	60
No. 11	5 : 95	98	65
No. 12	6~~.~~5 : 93~~.~~5	101	60

[0061]

Table II

Organic Components	y (wt% ~~by weight~~)	Boiling Point (°C)
1-Aminobutanol-2	$0_{x}3$	101
Monoisopropanolamine	$0_{x}8$	100
2-Amino-2-methyl-propanol-1	$1_{x}3$	102
2-Amino-2-methyl-propandiol-1,3	$1_{x}5$	101
3-(Aminomethyl-) pyridine	$0_{x}16$	101
Ethanolamine	$0_{x}3$	104
Aminoacetaldehyde-dimethylacetal	$2_{x}4$ $3_{x}4$ $4_{x}2$	101
4-Aminomorpholine	$0_{x}4$	101
1-Methylimidazole	$0_{x}1$	101
1,2-Dimethylimidazole	$0_{x}1$	100 – 102
1-Vinylimidazole	$0_{x}3$	101
DABCO	$0_{x}03$ $0_{x}08$ $0_{x}1$	101 – 103
1,5-Diazabicyclo-[4.3.0]non-5-ene	$0_{x}02$	101 – 103
1,8-Diazabicyclo-[5.4.0]undec-7-ene	$0_{x}02$	101 – 103
Acetic Acid (80-%~~ig~~)	$1_{x}5$	100 – 101
Hydroxyacetic acid	$0_{x}5$	100 – 101
Formic Acid	$1_{x}5$	100 – 101
Butyric Acid	$1_{x}2$	100 - 101

[0062] The boiling point (°C) of the azeotropic preparation ~~made up of~~formed from water, dipropyleneglycolmono-n-propylether~~,~~ and the indicated compounds ~~indicated~~ is also given in Table II.

[0063] The invention ~~is illustrated~~will be explained by the following examples~~, but is not restricted to these examples~~ without however being limited thereto.

Example 1

[0064] The drum of the cleaning device 12 described above was charged with to-be-cleaned material~~ to be cleaned~~. The material, consisting of textiles, was treated in ~~a~~the first step ~~treated~~ under liquid cleaning conditions with azeotropic preparations at elevated temperatures. The azeotropic preparations and the ~~pertinent~~respective treatment temperatures are indicated in Table I above. The material was ~~dipped~~immersed in~~to~~ the ~~hot~~warm azeotropic preparation ~~during agitation~~while being moved. The ~~hot~~warm azeotropic preparation was fed in a closed loop from the drum of the cleaning device 12 through a filter device 16 and delivered to the ~~separation compartment~~precipitation chamber 4. In the filter device 16, predominantly inorganic fouling (salts) ~~was deposited and also removed~~precipitated, which was drawn off. In the precipitation chamber 14, predominantly fat-containing fouling precipitated, which was likewise drawn off.

[0065] The first treatment step was followed by a second treatment step, which was also carried out under liquid treatment conditions. Fresh azeotropic preparation (see Table I for the composition; in each ~~operation~~run, the azeotropic preparation of the second treatment step ~~was of~~had the same composition as that of the first step) was ~~fed~~supplied to the drum of the cleaning device 12 at an elevated temperature. The material was ~~delivered~~supplied in a second closed loop from the drum of the cleaning device 12 to the ~~separation compartment~~precipitation chamber 4 ~~by way of~~via a filter device 16. The separation of inorganic and organic substances ~~were separated~~took place in the same way as in the first treatment step.

[0066] The second treatment step was followed by a third treatment step, in which the to-be-treated material ~~to be treated~~ was treated with the vapor of the ~~particular~~respective azeotropic preparation~~,~~ ~~the~~This had the composition (see Table I) ~~of which was that~~ typical ~~of~~for the

~~particular~~respective azeotropic preparation ~~(see Table I)~~. After passing through the ~~feed~~supply pump, the azeotropic preparation was converted into the vapor phase in a distillation device. The vapor was brought into intimate contact with the to-be-treated material ~~to be treated~~ in the drum of the cleaning device 12. Part of the vapor was condensed at the time of contact with the material. The liquid from the cleaning step ~~following~~occurring after the condensation was removed from the drum and, after passing through the filter device 16 ~~for separation of the organic substances~~, was ~~delivered~~supplied to the ~~separation compartment~~precipitation chamber 4 for separation of the organic substances, where organic contaminants were separated. The vapor, which was not already condensed in the drum of the cleaning device 12, was ~~with~~drawn off from the drum, condensed~~,~~ and (after optional filtration) ~~delivered~~supplied to the ~~storage~~reservoir tank 2 for ~~future~~further usage.

[0067] After drawing off the vapor of the azeotropic preparation ~~had been removed~~, the drum was evacuated, for example ~~at~~to 10^{-2} bar, and the remaining vapor was ~~removed~~drawn off in the same way as described above. The ~~hot~~ warm-treated material released the water and the organic components of the azeotropic preparation in the vacuum, ~~with the result that the material~~so that it was dry after 10 minutes of vacuum treatment.

[0068] The to-be-treated material ~~to be treated~~ was in much better condition than~~t~~ such material that has been treated ~~by~~in the conventional ~~means~~way. Both inorganic and organic fouling substances were entirely removed ~~in their entirety~~. The material ~~gave off~~had no unpleasant odor and ~~was outstanding in~~an excellent appearance. It ~~was successfully~~could be ironed and/or pressed with good results.

[0069] The third step (vapor treatment) is not ~~absolutely~~ necessarily required after liquid cleaning; equally good results ~~just as good~~ as those described above ~~can~~were also ~~be obtained with no~~achieved without the vapor treatment. It ~~is claimed for the invention that it~~ is also possible according to the invention to completely or partially replace the steps of treatment of to-be-cleaned material ~~to be treated, in whole or in part, by~~with liquid azeotropic preparation with steps of treatment with azeotropic preparation in vapor form. Equally good cleaning results were ~~obtained~~achieved with this procedure as well.

Example 2

[0070] Defectively-printed circuit boards or templates ~~produced in~~from the SMD-manufacture~~ing~~ were treated with a three-component mixture made of water, dipropyleneglycolmono-n-propylether and/or an amine compound and/or an N-heterocyclic compound and/or organic acids, such as is shown by way of example in Table II. The three-component mixtures, which were used as the active cleaning liquids, ~~consisted~~were composed of 90 ~~percent by weight~~wt% water, (10 - y) ~~percent by weight~~wt% dipropyleneglycolmono-n-propylether~~,~~ and y ~~percent by weight~~wt% of one of the compounds listed in Table II. The ~~C~~cleaning ~~was accomplished by~~took place in the spray process.

[0071] ~~In order to remove SMD adhesives, the~~The circuit boards ~~or~~and templates, respectively, were treated with the liquid azeotropic preparations for removing SMD adhesive at the boiling points~~temperatures~~ indicated in Table II with ~~liquid azeotropic preparations, the treatment being accompanied by application~~usage of ultrasound (ultrasound is not, however, ~~absolutely~~ necessarily required for ~~obtaining~~achieving good cleaning results). The azeotropic preparations were in the form of a milky emulsion, which became almost clear ~~when~~during application of ultrasound ~~was applied~~. ~~All traces~~A complete removal of the adhesives ~~were removed~~took place, without the need for providing protective devices in the system, such as ~~ones~~for protecting against explosions.

[0072] The cleaning results were considerably better than ~~those obtained by application of~~when using conventional solvents such as butyl acetate or isopropanol. In addition, in the case of the latter two, ~~it is absolutely necessary to provide~~a protection of the system from ~~against~~ explosions must necessarily be provided for ~~labor safety~~ reasons of workplace safety.

Claims

1. A ~~process~~method for cleaning ~~articles~~objects, in which a vapor produced by heating an active cleaning liquid is brought into contact with ~~articles to be cleaned~~to-be-cleaned objects, characterized in that ~~there is used as active cleaning liquid~~ an azeotropic preparation in the form of a mixture made of water and at least one additional component ~~with~~having molecules ~~having~~with hydrophilic and lipophilic groups is used, wherein the additional component(s) and the water form~~ing~~ an azeotrope ~~during~~at the phase transition liquid phase/~~-to-~~vapor phase ~~transition~~.

2. A ~~process as described in~~method according to Claim 1 comprising the steps in which:

- an azeotropic preparation is ~~prepared~~formed ~~with~~ from water and at least one component ~~with~~having molecules ~~having~~with hydrophilic and lipophilic groups~~,~~ in a weight ratio (component(s) ~~having~~with hydrophilic and lipophilic groups) : ~~to~~ water of 0.05-99.95 to 99.5-0.05;

- ~~articles to be cleaned~~the to-be-cleaned objects are brought at least once into contact with the azeotropic preparation and liquid azeotropic preparation is allowed to drain off, ~~including~~inclusive of impurities from to-be-cleaned objects removed thereby ~~the latter, is drained from the articles to be cleaned~~;

- residues of the azeotropic preparation on and/or in the ~~articles to be cleaned~~to-be-cleaned objects are removed by evaporation; and

- the vapor of the azeotropic preparation is condensed and the azeotropic preparation recovered by condensation is used for a ~~repeated~~ cleaning step once again.

3. A ~~process as described in~~method according to Claim 1 or Claim 2, wherein ~~articles to be cleaned~~the to-be-cleaned objects are brought at least once into contact with a vapor of the azeotropic preparation and, during the duration of the contact, the vapor of the azeotropic preparation is allowed to condense on the ~~articles to be cleaned~~to-be-cleaned objects.

4. A ~~process as described in~~method according to one of Claims 1 to 3, wherein ~~use is made as active cleaning liquid of~~ an azeotropic preparation is used as the active cleaning

liquid in the form of a mixture made of water and at least one additional component ~~with~~having molecules ~~having~~with hydrophilic and lipophilic groups, wherein the additional component(s) and the water form~~ing~~ an azeotrope ~~during~~at the phase transition ~~from~~ liquid phase~~/ to~~ vapor phase and the azeotrope ~~being~~is an azeotrope ~~with~~having an immiscibility gap at a temperature between 0 °C and the temperature of the phase transition ~~from~~ liquid phase~~/ to~~ vapor phase ~~under normal~~at standard pressure, preferably an azeotrope ~~with~~having an immiscibility gap at a temperature in the range from 20 °C and 110 °C ~~under normal~~at standard pressure.

5. A ~~process as described in~~method according to one of claims 1 to 4, wherein ~~use is made, in addition to water, as additional component of the active cleaning liquid,~~ an organic component of the general formula

$$R^1\text{-}[X]_n\text{-}R^3$$

is used, in addition to water, as a further component of the cleaning-active liquid, wherein~~: in which~~

- R^1 and R^3 each independently represents H; straight-chain or branched, saturated or unsaturated~~,~~ C_1- to C_{12}~~-~~alkyl groups, in which one or more nonadjacent -CH_2- groups ~~may~~can be replaced by -O-; saturated or unsaturated cyclic C_1- to C_8~~-~~alkyl groups, in which one or more nonadjacent -CH_2- groups ~~may~~can be replaced by -O-; hydroxy; C_1- to C_8-alkoxy; amino, ~~in which~~wherein one or both hydrogen(s) ~~may~~can be replaced by C_1- to C_8-alkyl groups; and

X represents -O-; -C(=O); -C(=O)-O-; -NH-, -NR^1-; -N(-OH)-; straight-chain or branched~~)~~ ~~-~~(-C_1- to C_8-) alkylene groups in which one or more nonadjacent –CH_2- groups ~~may~~can be replaced by -O-; and n represents integers 1, 2, 3, etc.

6. A ~~process as described in~~method according to one of Claims 1 to 5, wherein the mixture ratio of water and the additional component(s) ~~established~~ in the azeotropic preparation is ~~more or less~~substantially set at the ratio, which is present in the vapor that result~~sing from~~by heating ~~of~~ the liquid azeotropic preparation.

7. A ~~process as described in~~method according to one of Claims 1 to 6, wherein ~~there is added to the active cleaning liquid~~ at least one cleaning booster, which does not ~~spontaneously evaporate~~independently vaporize, and/or at least one corrosion ~~proofing~~preventing additive is added, preferably at least one cleaning booster, which does not ~~spontaneously evaporate~~independently vaporize, and/or at least one corrosion ~~proofing~~preventing additive ~~which~~that ~~is~~ distill(s)~~ed~~ with the azeotropic preparation.

8. A ~~process as described in~~method according to one of Claims 1 to 7, wherein an azeotropic preparation made of water and ~~an~~one organic component is used as the active cleaning liquid.

9. A ~~process as described in~~method according to one of Claims 1 to 8, wherein ~~there is used as active cleaning liquid~~ an azeotropic preparation made of water and ~~an~~one organic component is used in relative amounts of (100 - x) ~~percent by weight~~wt% : x ~~percent by weight~~wt%, wherein x is in the range $0 < x \leq 35$, preferably in the range $3 \leq x \leq 25$, ~~and by special preference~~particularly preferably in the range $4 \leq x \leq 15$.

10. A ~~process as described in~~method according to one of Claims 1 to 7, wherein ~~there is used as active cleaning liquid~~ an azeotropic preparation made of water and two organic components is used as the active cleaning liquid, preferably an azeotropic preparation made of water, dipropyleneglycolmono-n-propylether and an additional organic component.

11. A ~~process as described in~~method according to one of Claims 1 to 10, wherein ~~there is used as active cleaning liquid~~ an azeotropic preparation made of water, a glycol ether, preferably dipropyleneglycolmono-n- propylether, and an additional organic component is used as the active cleaning liquid in relative amounts of 90 ~~percent by weight~~wt%: (10 -y) ~~percent by weight~~wt% : y ~~percent by weight~~wt%, wherein y is in the range $0 < y \leq 5$, preferably in the range $0 < y \leq 2$.